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Remarks

Claims 1-12 are currently pending in the present patent application, with claim 13 having been cancelled through the above claim amendments. Claim 1 has been amended to more particularly point out and distinctly claim the recited subject matter. This amendment does not narrow the scope of claim 1.

In a final Office Action mailed 5 June 2006, the Examiner maintained the rejections of claims 1-6, 9, and 11-12 under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent Application Publication No. 2002/0164523 to Shibata *et al.* ("Shibata"). Claims 7-8 and 10 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Shibata in view of U.S. Patent Application Publication No. 2002/0028367 to Sammes *et al.* ("Sammes").

On September 7, 2006, the undersigned along with the inventor Partha Sarkar and Brian Y. Lee, Canadian counsel for the assignee of the present application, held a telephone interview with the Examiner to discuss the rejections of the pending claims. As set forth in the Examiner's Interview Summary mailed September 12, 2006, no agreement was reached as to the allowability of any of the claims. More specifically, with regard to claim 1, the Examiner contends that the alumina ceramic of the Shibata reference corresponds to the porous ion-conducting structure recited in claim 1. See page 3 of the Interview Summary. The Examiner contends that even if the alumina ceramic is considered in the prior art as an insulating material, this material is nonetheless capable of conducting some ions, even if such ion conductivity is poor. *Id.* The Examiner requested objective evidence to support that such an alumina ceramic is "incapable" of transporting ions, meaning that the material exhibits no ion conduction at all. *Id.* During the interview, the Examiner also raised what he termed a potential 35 U.S.C. § 112, paragraph 1, issue regarding the recitation of an ion-conducting structure in the claims and pointed to paragraph 19 of the specification to support his assertion that only a description of oxygen ion conducting materials is contained in the application.

In order to help the Examiner appreciate certain distinctions between the pending claims and the subject matter of the applied references, a disclosed embodiment of the invention will now be discussed in comparison to the applied references. Specific distinctions between the pending claims and the applied references will be discussed after the discussion of the disclosed embodiment and the applied references. This discussion of the differences between the disclosed embodiment and applied references does not define the scope or interpretation of any of the claims.

Embodiments of the present invention are directed to an anode-supported solid oxide fuel cell (SOFC) including an anode support layer. A suitable material for the anode support layer (ASL) is yttria stabilized zirconia (YSZ). See, e.g., paragraph 8 of the present application. YSZ is an excellent conductor of negatively charged oxygen (oxide) ions at high temperatures. See paragraph 3. A SOFC operates at an elevated temperature, typically in the order of between 700-1000 °C. *Id.* YSZ is a solid oxide electrolyte and an oxygen ion conductor suitable for use in a SOFC. See, e.g., page 101 of the Suresh publication, which accompanies this amendment as Attachment 1. Other oxygen ion conducting materials suitable for use in a SOFC may be substituted for YSZ in the anode support layer. See paragraph 19. A characteristic of a solid electrolyte, which may otherwise be known as a fast ion conductor or a superionic solid, is a high electrical conductivity in the range of 10⁻¹ - 10⁻⁴ ohm⁻¹ · cm⁻¹ (i.e. a resistivity of 10-10,000 ohm · cm). See page 17 of Attachment 1. In contrast, alumina (aluminum oxide) has a resistivity of 5.0 X 10⁸ at 700°C and 2 X 10⁶ at 1000°C (see page 959 of the Shackelford and Alexander publication, which accompanies this amendment as Attachment 2) and thus is not a solid electrolyte/fast ion conductor/superionic solid suitable for SOFC use. See also the article that accompanies this amendment as Attachment 3 for additional information regarding resistivity and the listing of Web sites in Attachment 4 that illustrate alumina being used as an insulator.

Turning now to the Shibata patent, the Examiner points to paragraph 69 of Shibata as disclosing an SOFC unit cell having a porous base body 1 which

includes a ceramic (alumina) body plated with Ni, an electrode 10, an electrolyte 12, and an electrode 11. The base body 1 material (alumina) simply cannot be considered a porous oxygen ion conducting structure suitable for solid oxide fuel cell use. As shown in accompanying samples of scientific literature, alumina's resistivity is too high for this material to be considered a solid electrolyte and an oxygen ion conductor suitable for use in a SOFC. In order for a material to be considered an oxygen ion conductor suitable for SOFC use in an electrode, the material must provide the necessary and efficient ionic path for anodic reaction which takes place during SOFC operation. As is well known in the SOFC art, the ionic conductivity of the anode must be comparable to the ionic conductivity of the electrolyte, and thus alumina's resistivity is also too high at SOFC operating temperature to carry out SOFC electrode function.

The Examiner cannot contend that because alumina must exhibit some ion conductivity, the base body 1 of Shibata may be considered to correspond to the anode support layer of the present application. Materials are classified as having physical characteristics that result in each material being placed in a particular class of materials, such as an electric or thermal conductor or insulator or an ionic conductor or insulator. Materials are not classified in absolute terms as is suggested by the Examiner. The Examiner requests evidence that "ceramic alumina is INCAPABLE of transporting ions (no ion conduction at all)." See page 3 of the Interview Summary. No such evidence can be provided for any material. Although classified as a particular type of material, every material will exhibit some characteristics of another class of materials. For example, materials classified as electrical insulators exhibit some amount of electrical conductivity, but such conductivity is so small that these materials are nonetheless classified as insulators. If the Examiner's argument was accepted, then the classification of materials would be rendered pointless. Any material could be said to be whatever type of material was needed by an Examiner when formulating a rejection.

Pursuant to MPEP § 2111, during patent examination the pending claims must be given their broadest reasonable interpretation consistent with the

specification. The Examiner expressly mentioned this well known tenet of patent examination. As expressly set forth in Section 2111, the "broadest reasonable interpretation of the claims must also be consistent with the interpretation that those skilled in the art would reach." As evidenced by the accompanying technical literature, as well as the comments of the inventor Partho Sarkar during the telephone interview with the Examiner, one skilled in the art would not interpret the phrase "ion-conducting structure" to include the insulating material of alumina ceramic. The Examiner's attempt to so interpret this phrase is simply put an unreasonable interpretation of this language. Although the Examiner cites the "broadest reasonable interpretation" language of Section 2111 as the rationale for his interpretation, such an interpretation of this language plainly in violation of this section of the MPEP as well as in contravention of common sense.

Now turning to the claims, amended claim 1 recites an anode-supported solid oxide fuel cell including an anode support layer. The anode support layer includes a porous oxygen ion-conducting structure suitable for solid oxide fuel cell use and having pores impregnated with a catalytic and electronically conductive material. An electrolyte layer is in adjacent intimate contact with the anode support layer and a cathode layer is in adjacent intimate contact with the electrolyte layer.

Shibata neither discloses nor suggests an anode support layer as recited in amended claim 1. The base body 1 of Shibata simply cannot be said to correspond to the recited anode support layer. As discussed above, an alumina ceramic as set forth in paragraph 69 of Shibata simply is not "a porous oxygen ion-conducting structure suitable for solid oxide fuel cell use." Because an alumina ceramic exhibits some ion conductivity does not make such an alumina ceramic an ion-conducting structure. As previously discussed with reference to the attached technical literature, alumina's resistivity is too high for this material to be considered a solid electrolyte and an oxygen ion conductor suitable for use in a SOFC. Such an alumina's resistivity is also too high at SOFC operating temperatures to carry out the function of an SOFC electrode.

Furthermore, claim 1 recites an electrolyte layer in intimate contact with the ASL. Shibata discloses electrodes 10 and 11 to be in intimate contact with the electrolyte, and neither electrode 10, 11 of Shibata corresponds to the structure of the ASL as recited in claim 1, i.e. a porous oxygen ion conducting structure suitable for SOFC use and having pores impregnated with a catalytic and electronically conductive material. Although the Examiner suggests that the porous base body 1 in Shibata discloses the ASL as presently claimed, such base body is not in intimate contact with the electrolyte, nor can the base body material (alumina) be considered a porous oxygen ion conducting structure suitable for solid oxide fuel cell use.

For all these reasons, the combination of elements recited in amended claim 1 is allowable. Dependent claims 2-11 are allowable for at least the same reasons as claim 1 and due to the additional limitations added by each of these claims.

It should be pointed out that amended claim 1 now expressly recites that the anode support layer includes a "porous oxygen ion-conducting structure." Support for this is found, for example, in paragraph 12 of the application. This amendment should render moot any potential Section 112 issues alluded to by the Examiner in the Interview Summary. See page 3 of the Interview Summary. These comments are not meant to indicate that the undersigned agrees there ever were any Section 112 deficiencies with the prior claim language. Also note that this amendment in no way necessitates a new search by the Examiner since, as admitted by the Examiner, the prior language could have been construed to include any type of ion-conduction structure so surely the prior search included oxygen ion-conducting structures. The same is true of the amendment that the oxygen ion-conducting structure is "suitable for solid oxide fuel cell use." This amendment merely expressly recites what was implicit before and is in direct contrast to the structure and function of the relied upon components in Shibata, which are not suitable for solid oxide fuel cell use." The same is true for the amendments of claim 12, which will now be discussed in more detail below.

Amended claim 12 recites an anode-supported solid oxide fuel cell comprising an anode support layer including an oxygen ion-conducting structure suitable for solid oxide fuel cell use and with a plurality of vias extending through the thickness of the oxygen ion-conducting structure. At least some of the vias are filled with electronically conductive material. An anode functional layer is in adjacent intimate contact with the anode support layer and an electrolyte layer is in adjacent intimate contact with the anode functional layer. A cathode layer is in adjacent intimate contact with the electrolyte layer.

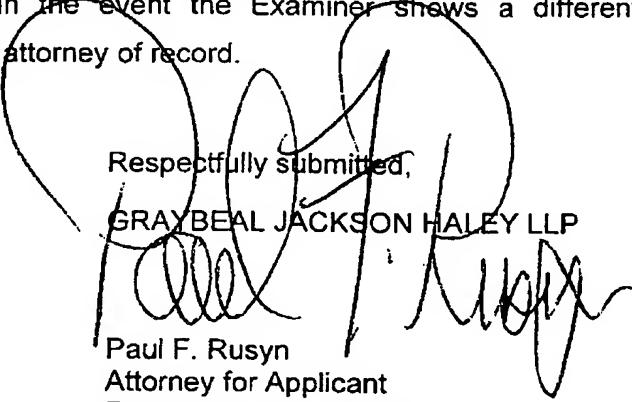
Shibata neither discloses nor suggests an anode support layer as recited in amended claim 12. The base body 1 of Shibata simply cannot be said to correspond to the recited anode support layer since an alumina ceramic is not an oxygen ion-conducting structure suitable for solid oxide fuel cell use. Simply because an alumina ceramic exhibits some ion conductivity does not make such an alumina ceramic an ion-conducting structure. Alumina's resistivity is too high for this material to be considered a solid electrolyte and an oxygen ion conductor suitable for use in a SOFC and the resistivity is also too high at SOFC operating temperatures to carry out the function of an SOFC electrode.

For all these reasons, the combination of elements recited in amended claim 12 is allowable.

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The present patent application is in condition for allowance. Favorable consideration and a Notice of Allowance are respectfully requested. The Examiner is requested to contact the undersigned at the number listed below for a telephone interview if, upon consideration of this amendment, the Examiner determines any pending claims are not in condition for allowance. The undersigned also requests the Examiner to direct all future correspondence to the address set forth below in the event the Examiner shows a different correspondence address for the attorney of record.

Respectfully submitted,
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Attachment

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*super-
ionic
solids* PRINCIPLES
AND
APPLICATIONS

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CHAPTER 2

Superionic Materials and Structures

Superionic solids are ionic materials with high electrical conductivity comparable with those of liquid electrolytes. These materials are also termed "solid electrolytes" or "fast ion conductors". Typically a superionic solid has the following characteristics:

- (i) crystal bonding is ionic;
- (ii) electrical conductivity is high ($10^{-1} - 10^{-4} \text{ ohm}^{-1} \text{ cm}^{-1}$);
- (iii) principal charge carriers are ions which means that the ionic transference number (t_{ion}) is almost equal to 1 (here t_{ion} refers to the fractional contribution of the ionic conductivity to the total conductivity);
- (iv) the electronic conductivity is small; generally materials with electronic transference number (t_e) less than 10^{-4} are considered satisfactory superionic solids.

The values of electrical conductivity of a few ionic and superionic solids are shown in Figure 2.1. The highest conductivity at room temperature obtained so far is for RbAg_4I_5 which is $0.27 \text{ ohm}^{-1} \text{ cm}^{-1}$. This is many orders of magnitude higher than those of the more commonly known ionic solids KCl , NaCl etc. which have room temperature conductivity $\sim 10^{-12} - 10^{-16} \text{ ohm}^{-1} \text{ cm}^{-1}$. It may be noted that most of the superionic materials attain a high electrical conductivity above a certain temperature which may or may not be well defined. In other words, with increasing temperature the electrical conductivity sometimes changes gradually (as in β -alumina) or shows an abrupt jump (e.g. in $\beta\text{-AgI}$, RbAg_4I_5 etc.). Furthermore, for the latter materials the abrupt conductivity change is sometimes associated with a distinct structural change (like the $\beta \rightarrow \alpha$ transition in AgI) but sometimes this is not so clear (as in RbAg_4I_5). Structures which allow fast ion transport are generally disordered, "channelled" or "layered" (Wiedersich and Geller 1971). Ion-Ion interactions or correlation

over, Owens (1971) has noted that M^+ ions with volumes greater than $85(\text{\AA}^3)$ do not generally form conductive compounds. Furthermore, for bigger cations a lesser amount may be needed. For example, the maximum conductivity is obtained with 13 mole % MI for the $(\text{CH}_3)_4\text{NI}-\text{AgI}$ system, 12.5 mole % in the $(\text{CH}_3)_2(\text{C}_2\text{H}_5)_2\text{NI}-\text{AgI}$ system and 12 mole % in the $(\text{C}_2\text{H}_5)_4\text{NI}-\text{AgI}$ system. This means that the percentage of added cations decreases with its increasing size as is expected from Raleigh's picture.

The above structural principles have been deduced on the basis of the very small amount of available structural data — mostly on cation substituted systems. More structural studies would be necessary both on anion and cation substituted systems to arrive at a better understanding.

2.8 Oxygen ion conductors

The first solid oxide electrolyte ever used was probably the ceramic with composition 85 wt % ZrO_2 , 15 wt % Y_2O_3 which was used by Nernst (1899) as an incandescent lighting material. Later Baur and Preis (1937) used this material for a fuel cell. The definite conductivity mechanism in terms of oxygen vacancies was proposed by Wagner (1943) and later verified by Hund (1952). However, the sudden increase of scientific interest in such materials started after Kiukola and Wagner (1957a, 1957b) illustrated their use in high-temperature thermodynamic measurements and fuel cells. In principle, almost all oxides can be expected to show some degree of oxygen ion conduction particularly the non-stoichiometric oxides. The non-stoichiometry can be created by heating the metal oxides in vacuum or oxygen or the relevant metallic vapour (Wagner 1974). Most of the oxygen ion conductors are good only at high temperatures ($\sim 1000^\circ\text{C}$) and are mixed conductors (ionic + electronic + electron-hole). As in the case of other ionic conductors, the conductivity in this case is strongly dependent on the temperature and doping with aliovalent impurities (like Ca^{2+} , Y^{3+} , Sr^{2+} etc. in HfO_2 , CeO_2 etc.) which control the number of point defects and their mobility. However, a unique property of oxide conductors is the dependence of the conductivity on the ambient pressure or activity. If the ambient oxygen pressure is low, the oxygen ions (O_O) would leave the solid electrolyte according to the following mechanism[†]:

[†] The defects are expressed in the Kröger-Vink notation: the symbol indicates the defect; the subscript the location of the defect; and the superscripts (') (") denote negative and positive charges respectively. For example $V\text{O}_2^+$ means vacancy at the oxygen site having effectively two positive charges. Similarly, $\text{O}_\text{I}^{\prime\prime}$ would indicate an oxygen ion at the interstitial site with effectively two negative charges.

tions, cooperative hopping or correlation effects play important roles. Details of the conductivity mechanism will be discussed in Chapter 4. Figure 2.46 gives a schematic plot of conductivity as a function of partial pressure of ambient oxygen for a typical oxide electrolyte at three different temperatures. The higher the temperature, the lower is the range of oxygen pressure over which the conductivity is ionic. The dependence of the range of ionic conduction on concentration of aliovalent dopant (like Ca^{2+} or Y^{3+}) is shown in Figure 2.47. The effect of increasing concentration is to broaden the range of ionic conductivity and shift the whole conductivity curve to lower p_{O_2} values.

Most of the useful oxide electrolytes developed so far are based on ThO_2 , CeO_2 , HfO_2 and zirconia, though some other systems have also been described. For an earlier review see Etsell and Flengas (1970). The common structure which sustains high oxygen ion conduction is the "fluorite structure". The fluorite structure for MO_2 (M = metal ion Th, Ce etc) is shown in Figure 2.48. In this structure there are a large number of octahedral interstitial voids. Each metal cation is surrounded by eight

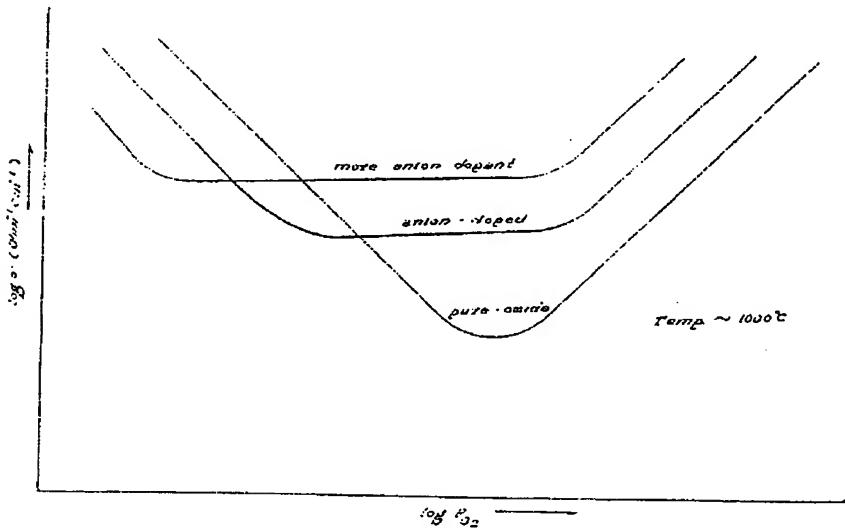


Fig. 2.47 Schematic representation of the dependence of conductivity of any oxide ion electrolyte on oxygen partial pressure for samples doped with different concentrations of aliovalent anion (Ca^{2+} , Y^{3+} etc.).

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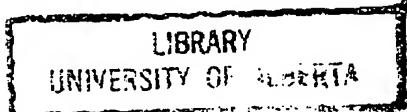
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**MATERIALS SCIENCE
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THIRD EDITION

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and

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Electrical Properties

Table 291. RESISTIVITY OF CERAMICS
(SHEET 4 OF 6)

Class	Ceramic	Resistivity (Ω -cm)	Temperature Range of Validity
Oxides	Aluminum Oxide (Al_2O_3)	$>10 \times 10^{14}$	25°C
		2×10^{13}	100°C
		1×10^{13}	300°C
		6.3×10^{10}	500°C
		5.0×10^8	700°C
		2×10^6	1000°C
	Beryllium Oxide (BeO)	$>10^{17}$	25°C
		$>10^{15}$	300°C
		$1-5 \times 10^{15}$	500°C
		$1.5-2 \times 10^{15}$	700°C
	Magnesium Oxide (MgO)	$4-7 \times 10^{15}$	1000°C
		1.3×10^{15}	27°C
		$0.2-1 \times 10^8$	1000°C
	Silicon Dioxide (SiO_2)	4×10^2	1727°C
		10^{18}	room temp.
	Zirconium Oxide (ZrO_2) (stabilized)	2300	700°C
		77	1200°C
		9.4	1300°C
		1.6	1700°C
		0.59	2000°C
		0.37	2200°C

Source: data compiled by J.S. Park from No. 1 Materials Index, Peter T.B. Shaffer, Plenum Press, New York (1964); Smithells Metals Reference Book, Eric A. Brandes, ed., in association with Butterworths Research Institute Ltd. 6th ed. London, Butterworths, Boston, (1983); and Ceramic Source: American Ceramic Society (1986-1991).

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Attachment 3

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Summary of Comments on Steele

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Materials for fuel-cell technologies

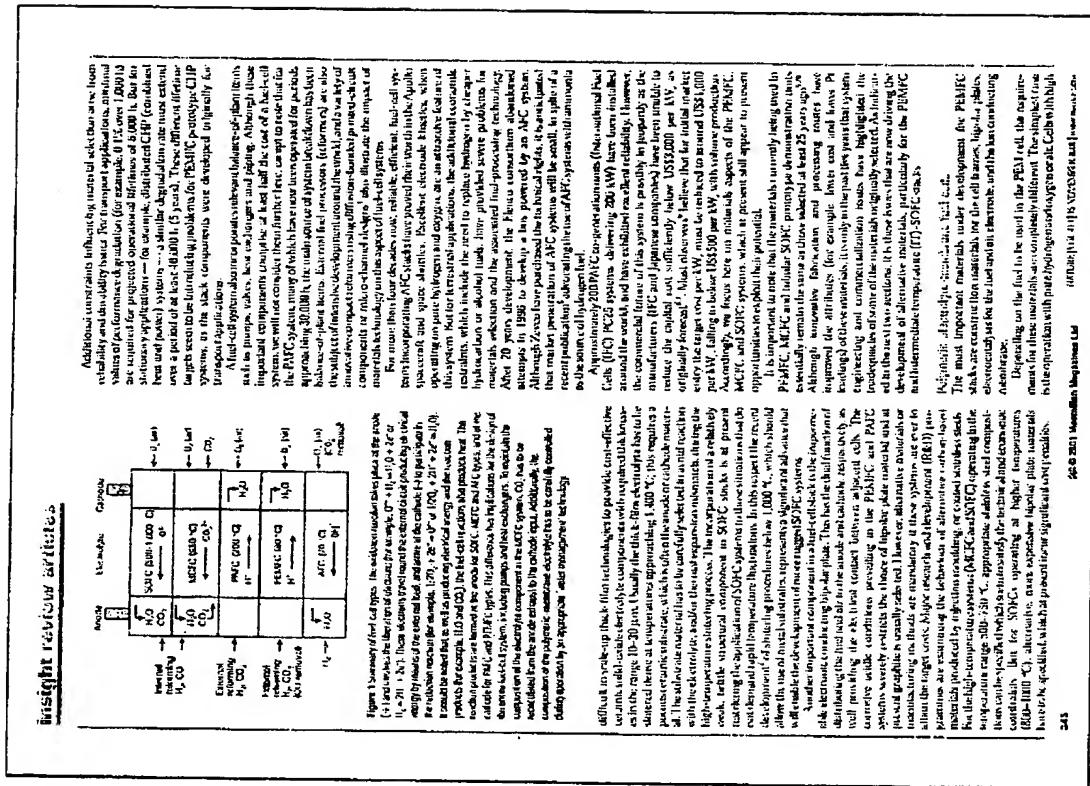
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the first and largest of the *Leptospiral* isolates, isolated from *Leptospiral* patients in the Tigray region, Northern Ethiopia (isolated in 1978) (Tigray, Northern Ethiopia) (isolated in 1978) (Tigray, Northern Ethiopia).

The survival of a portion of the field population has been observed in a portion of a prairie field that was last harvested about 100 years ago. However, in spite of the other, often favorable, conditions, and in contrast to the herds associated with the typical prairie, it has been difficult to develop the typical prairie herds associated with the typical prairie herds. This problem is now being studied with a view to determining the cause of the difficulty, and to developing a method of control that will render the prairie herds as numerous as possible.

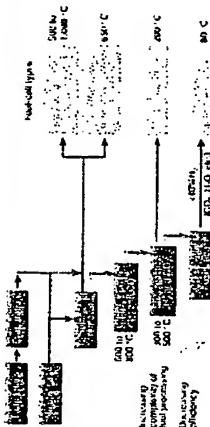
Glossary of terms used in the text

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whence $q = 1$ is: $1 + \frac{1}{2} + \frac{1}{3} + \dots + \frac{1}{n} = \frac{1}{n} \ln n + \frac{1}{2} + \dots$
 or $\ln n = n \left(\frac{1}{n} - \frac{1}{2} - \dots \right)$

Consequently, the *in vitro* growth of *Escherichia coli* in the presence of *Leuconostoc* sp. was inhibited.

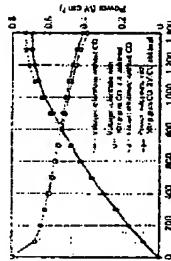
REFERENCES
The most important problems in molecular virology are:
For cooperation with the cytological side, particularly the nature of the material. Whether the new properties of phenomena can be explained

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Opposed have been developed, and the evolution in molecular biology of the cell performance, its level, and function (cell activity). The plasmatic boundary (cell membrane) is an important (cellular) boundary.

For application of elevated temperatures which is feasible with our high density DMFC systems and for relatively fast fuel cell start-up times, the 100°C isothermal annealing method becomes the dominant tool. In the type of membrane used for the first DMFC

Although the US Criminal Justice System (CJS) initiated the development of POGAs in the 1970s, it was the introduction of the National Sex Offender Registry (NSOR) by California that ushered continued development of these systems.

of PBL with phospho-kinase to acidify extracellular environments. Later developments led to acidification of proteins with PBL and subsequent analysis of the acidified proteins. Proteins selected for analysis were then analysed by SDS-PAGE and immunoblotting. Results are reported for the acidification of proteins in the presence of PBL and for the acidification of proteins in the presence of PBL and the addition of a specific inhibitor of the enzyme cathepsin B. The results are discussed in the light of the results of the present study.

The developments have taken many years and Adam-type M&As, although savings of the expert knowledge have to be transferred into the system.

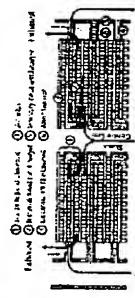
Such an effect is manifested by (1) the effect of the temperature on the properties of the material, which is dependent on its chemical composition and the type of the material (2) the effect of the temperature on the properties of the material, which is dependent on its chemical composition and the type of the material.

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Insight Review



contains that the *long* *trunk* *represents* *a* *cellular* *process* *of* *cellular* *processes* *7/1*, which *was* *extremely* *thin* *near* *its* *apical* *portion* *than* *the* *trunk* *itself*, *7/1*. *In* *principle*, *the* *use* *of* *two* *short* *electrodes*, *such* *as* *(CC)* *should* *allow* *the* *development* *of* *more* *precise* *and* *more* *definite* *results*, *7/1*. *Fig* *(C)*, *7/1*, *represents* *the* *apparatus* *used* *in* *connection* *with* *IPN* *studies* *concerning* *the* *harm* *caused* *by* *heat* *radiation*, *heat* *radiation* *being* *most* *important* *in* *this* *field*. *It* *is* *well* *known*, *7/1*, *that* *heat* *radiation*, *7/1*, *irradiation*, *(CC)*, *can* *be* *utilized* *as* *a* *method* *of* *treating* *the* *skin*, *7/1*, *in* *connection* *with* *the* *skin* *complications* *of* *the* *skin* *and* *the* *electrode*, *7/1*, *is* *located* *at* *the* *bottom* *of* *the* *IPN* *apparatus*, *7/1*, *and* *is* *connected* *with* *the* *heat* *radiation* *apparatus*, *7/1*, *located* *at* *the* *top* *of* *the* *IPN* *apparatus*, *7/1*. *The* *apparatus*, *7/1*, *is* *designed* *so* *that* *the* *skin* *can* *be* *located* *at* *the* *bottom* *of* *the* *IPN* *apparatus*, *7/1*, *and* *the* *heat* *radiation* *apparatus*, *7/1*, *can* *be* *located* *at* *the* *top* *of* *the* *IPN* *apparatus*, *7/1*. *Another* *apparatus*, *7/1*, *which* *has* *been* *utilized* *in* *connection* *with* *IPN* *studies*, *7/1*, *is* *the* *apparatus* *7/1*, *represented* *in* *Fig* *(D)*, *7/1*, *which* *is* *utilized* *in* *connection* *with* *the* *skin* *and* *the* *electrode*, *7/1*, *located* *at* *the* *bottom* *of* *the* *IPN* *apparatus*, *7/1*, *and* *the* *heat* *radiation* *apparatus*, *7/1*, *located* *at* *the* *top* *of* *the* *IPN* *apparatus*, *7/1*.

66-02001 Wissenschaftliche Begeisterung für die Naturwissenschaften

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Attachment 4

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Spar Plug use alumina since it is electrically insulator:

<http://vshsp.en.alibaba.com/search/offer>

Auto Ignition System use alumina since it is an insulator:

<http://starsparkplug.en.alibaba.com/offerlist.html>

Alumina insulating coating:

<http://www.freepatentsonline.com/6844023.html>

Shanghai Morgan Matroc Technical Ceramics Co.,Ltd

High efficiency alumina heat-electric insulator for welding and heat treatment. Morgan Technical Ceramics Shanghai produces a complete range of ceramic ...
www.morganmatrocsh.com/e_chapin_7.htm - 15k - [Cached](#) - [Similar pages](#)

Ortech industry -table containing alumina 's properties:

<http://www.ortechceramics.com/alumina.htm>

Ceramic Tube and Ceramic Rod Products - (111 companies)

Ceramic tube and ceramic rod products are suitable for use in applications requiring high temperature strength, erosion resistance, electrical or thermal insulation, and other specialized characteristics. [Search by Specification](#) | [Learn more about Ceramic Tube and Ceramic Rod Products](#)

Alumina insulator:

<http://www.prgtech.com/engineering.html>

Alumina use in thermocouple assembly as a insulator:

PDF Noble Metal

File Format: PDF/Adobe Acrobat
elements, elements with **insulators** or assemblies. A typical assembly includes a head, **alumina insulators** and a protecting ...
www.watlow.com/literature/specsheets/files/sensors/ricnom0305.pdf - [Similar pages](#)

Page 8 -shows use of alumina tube in an assembly as a insulator:

Henry Rohrs poster

File Format: PDF/Adobe Acrobat
Alumina Insulator. Nickel Seat. Gold O-Ring. SS O-Ring Seat. Vespel Support. Sapphire Ball. PZT Bimorph. Pulsed Valve. The pulsed valve consists of a ...
www.chemistry.wustl.edu/~msf/ASMS98/Pshenry98.pdf - [Similar pages](#)

Goodfellow- a table listing volume resistivity of alumina $>10^{14}$ ohm-cm.:

<http://www.azom.com/details.asp?ArticleID=2103>

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